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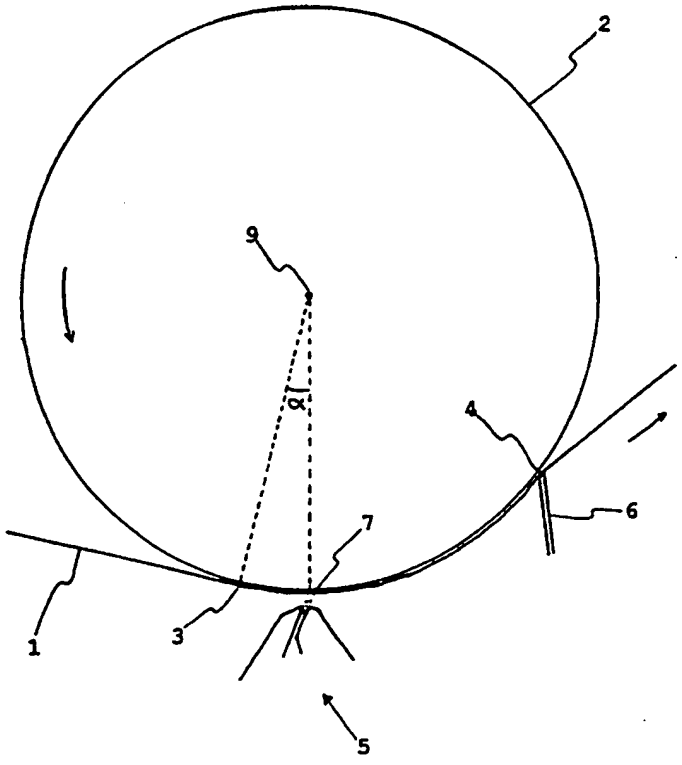
(57) Abstract

The invention relates to a jet applicator station used for coating a moving web (1) of paper or board and to a method of coating a web. The applicator station employed comprises a backing roll (2) supporting the moving web (1), a jet applicator (5) for applying the coating mix to the surface of the web (1) as a jet stream and a doctor means (6) for smoothing the applied coat. The separation of the web (1) from the surface of the backing roll (2), known in the art as bagging, that occurs during jet application is reduced by passing the web (1) onto the backing roll (2) not earlier than very close to the impact point (7) of the coat jet on the web. This goal is achieved by organizing the applicator station in a novel manner, or alternatively, using an extra guide roll for deflecting the travel direction of the web (1).



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Coating station and coating method

The present invention relates to a jet coating station according to the preamble of claim 1 for coating a moving web of paper or paperboard, said jet coating station comprising a backing roll, a jet applicator and a doctor means, whereby the web to be coated is arranged to pass through said station, and further relates to a method of coating a moving web of paper or paperboard.

The backing roll used in a jet coating station has a diameter of about 1 to 1.3 meters, for example, having its perimeter manufactured to a high circular accuracy. The function of the backing roll is to support the web passing through the coating station so as to keep the distance between the applicator jet nozzle and the web maximally constant, thus maintaining the quality of the applied coat as constant as possible. At the doctor, the backing roll forms a backing surface against which the doctor member presses the web. In order to assure a good coating result, the backing roll is rotated at a speed making the tangential velocity of the backing roll surface substantially equal to the speed of the web.

Conventionally, the applicator device, the doctor means and the web infeed to the coater is arranged at a jet coating station so that the jet applicator nozzle is typically placed immediately under the backing roll and the web is guided onto the backing roll obliquely from above at an acute angle of about 30 - 40° with regard to the horizontal plane. The doctor means, which may comprise a blade, bar or air knife doctor, is placed at a certain application dwell distance from the jet applicator nozzle in the travel direction of the web.

In prior-art techniques of jet coating, problems have been caused by the bagging of the web. In the present

context, the term bagging refers to the separation of the web from the surface of the backing roll within the area between the jet applicator nozzle and the doctor member as well as under the jet applicator nozzle. Resultingly, a bag-like formation develops into the moving web. The bagging effect can be traced to deviations in the force balance at the coating station. At the doctor means, the web is pressed against the backing roll under the linear pressure of the doctor member, whereby the situation is well under control. Over the web length preceding the doctoring point, the web is pressed against the backing roll by the machine-direction component of web tension and the relatively small vector component of the coating jet impact inflicted normally to the web surface. In practice, the forces acting to detach the web from the backing roll typically exceed the attracting forces, thus causing the web to separate from the surface of the backing roll.

Over the web area preceding the doctor, the web tends to be separated from the backing roll by the pressure of air getting entrapped between the web and the backing roll plus the centrifugal force inflicted on the paper web. The detaching force is chiefly imparted by the massive air layer which travels along with the web surface moving at a high speed. This voluminous air mass cannot follow the web into the nip under the doctor member, but rather begins to accumulate between the web and the backing roll. With the volume increase of the accumulated mass of air, the bag of web holding the air also grows until finally reaching an equilibrium, e.g., through a spontaneous deflation of the bag. Then, air escapes via the edges of the bag and it is also possible that the relief of bag pressure at the opening of the bag front edge may reduce the amount of air carried by the web. The centrifugal force tending to detach the web from the surface of the backing roll becomes effective at high web speeds and

is proportional to the web speed, base weight and angle of web travel deflection at the backing roll. Obviously, the web is also subjected to gravitational forces.

A problem in bagging is posed by the varying distance between the web surface and the jet applicator nozzle. In the worst case, the bag may have a thickness of up to 20-30 mm, while the optimal distance of the jet nozzle from the web surface is in the range of 3-30 mm, often about 6-20 mm. This causes obvious complications: in the center area of the cross-machine direction, where the bagging effect is at its worst, the web will separate from the backing roll so far as to meet the lip of the jet applicator nozzle. Resultingly, the nozzle lip will undergo rapid wear under the abrasion of the running web. On those intermediate cross-machine areas where the baggy web begins to detach from the jet applicator nozzle but does not yet meet the surface of the backing roll, the impact angle of the coat jet on the web will change. Such a change of the impact angle causes coating mix backflow, which in turn worsens the coat quality and increases the maintenance need of the nozzle. The worsening of the coat quality is caused by the accumulation of coat aggregates on the nozzle lip that guide the coat jet away from the surface to be coated.

It is an object of the present invention to overcome the disadvantages of the above-described technology and to provide an entirely new type of jet applicator station and a method of coating a moving web of paper or board.

The goal of the invention is achieved by passing the web to the backing roll of the jet applicator station just at the jet applicator nozzle or just slightly before it. More specifically, the jet applicator station according to the invention is characterized by what is stated in the characterizing part of claim 1 and the method

according to the invention is characterized by what is stated in the characterizing part of claim 4.

The invention offers significant benefits: the bagging effect at the jet applicator nozzle will be reduced substantially and the coat smoothness and quality is improved. The soiling of the applicator nozzle and the wear of the nozzle upper lip are reduced. The impact angle of the coating jet with the web to be coated can be kept constant over the entire cross-machine direction thus facilitating improved control of the formation of uncoated spots and coat backflow.

As an entity, the invention offers extended servicing intervals of the jet applicator station and a high-quality coat with a higher efficiency. In particular the invention improves the reliability of fast and wide coaters and the performance of short-dwell coaters.

In the following the invention will be examined in greater detail with the help of exemplifying embodiments by making reference to the appended drawings in which

Figure 1 shows a cross-sectional view of one embodiment of the jet applicator station according to the invention;

Figure 2 shows in an enlarged scale the cross-sectional view of those parts of the jet applicator station of Fig. 1 that are located close to the web; and

Figure 3 shows a cross-sectional view of another embodiment of the jet applicator station according to the invention.

Referring to Fig. 1, therein is shown a moving web 1 of paper or board and its path through the jet coating station. In this embodiment of the invention, the web is

guided to the backing roll 2 by means of a guide roll 8. By virtue of the guide roll 8, the angle of approach of the web 1 onto the backing roll 2 can be selected with a greater latitude of design. Supported by the backing roll 2, the web 1 travels through the jet applicator 5 and passes further to the doctor blade 4. Finally, the web exits the applicator station.

In Fig. 2 is shown in greater detail the principle of the invention and the basics of the implementation of the invention in this embodiment. The web 1 meets the backing roll 2 at an approach point 3. Assuming no bagging, the web 1 continues its travel essentially supported by the backing roll 2 to the jet applicator 5. The coat jet emitted by the applicator 5 hits the web 1 at an impact point 7. From the jet impact point 7, the web continues its travel further to a doctor blade 6 which is displaced at a dwell distance, after which the web is guided so that it leaves the surface of the backing roll 2 at a web take-off point 4. In the illustrated embodiment, the web take-off point 4 is located at the doctor blade 6. The diagrams do not illustrate the possible bagging of the web 1 over the area between the jet applicator 5 and the doctor blade 6.

To avoid bagging, the web 1 is passed tangentially onto the backing roll 2 only very close to the jet applicator 5 or even slightly after the applicator 5. The differential angle α between the web approach point 3 and the jet impact point 7 on perimeter of the backing roll 2 is in the range $-5 - +15°$, most advantageously $0 - +10°$. The differential angle is defined to be positive if the web approach point 3 is on the ingoing side from the jet impact point 7 and negative if the web approach point 3 is on the outgoing side of the web 1 from the jet impact point 7. In Fig. 2, the differential angle α is positive.

In the embodiment of Fig. 1, the invention is implemented by providing a jet applicator station with a separate guide roll 8 serving to guide a web 1, which conventionally approaches the backing roll 2 obliquely from above at an angle of about 30 - 40°, to meet the backing roll at a substantially smaller angle which has been found more advantageous. In coater designs having the jet impact point 7 arranged to hit the web orthogonally at the lowermost point of the backing roll 2, the approach angle α of the web relative to the horizontal plane as well as the relative height of the mounting position of the guide roll 8 may again be determined in a simple manner according to the above-described guideline.

In Fig. 3 is shown the web 1 of paper or board to be coated in conjunction with another embodiment of the jet applicator station according to the invention. In this embodiment, the web 1 is passed onto the backing roll 2 in a conventional manner obliquely from above at an angle of about 30 - 40° with respect to the horizonal plane. The differential angle α between the approach point 3 of the web 1 with the surface of the backing roll 2 (Fig. 2) and the impact point 7 of the coat jet on the web (Fig. 2) is controlled to a value specified in the invention by placing the jet applicator 5 in front (with regard to the travel direction of the web 1) of the vertical axis passing via the center point 9 of the backing roll 2 (Fig. 2), which arrangement is different from the prior art. The relative position of the jet applicator is set so that the differential angle α will be in the range of -5 - +15°, most advantageously 0 - +10°. Then, the impact point 7 of the coat jet (Fig. 2) is located at a circumferential advance angle of 15 - 45° on the rotating backing roll 2 with respect to the lowermost point of the backing roll 2. The doctor blade 4 is placed at the desired dwell distance from the jet applicator 5.

In addition to those described above, the invention may have alternative embodiments. Without departing from the specifications of the invention, it is possible to guide the web 1, for instance, at an angle different from that described above to the applicator station and then adapt the invention by placing the applicator station appropriately with regard to the selected approach angle of the web 1. In Fig. 1 is shown one embodiment having the web 1 passed onto the guide roll 8 at an angle of -5 - +5°, but the web 1 may as well be passed onto the backing roll 2, e.g., in the vertical direction if so desired. It is also possible to combine the use of the guide roll 8 of the web 1 with a placement of the jet applicator 5 different from the above-described design having the applicator located on the underside of the backing roll 2 or, alternatively, to arrange the guidance of the web by moving an existing roll of the paper machine into a new position. Further, the number or exact position of the guide rolls 8 is by no means restricted. Hence, it is possible to guide the web 1, e.g., vertically down onto the backing roll 2 over a guide roll 8 located higher in the coater station and respectively placing the jet applicator below the horizonal plane of and in front of the backing roll 2 with respect to the travel of the web at an angle of -5 - +15°, advantageously 0 - +10°, with respect to the horizontal plane of the backing roll 2.

It is also possible to place the jet applicator 5 in the applicator station so that the position of the applicator 5 is variable. Then, the position of the applicator 5 is advantageously made adjustable by virtue of complementing the applicator station with a remote-controlled actuator suited to change the position of the applicator 5 during application, too. Then, the differential angle α can be adjusted as required for any particular run-time coating situation. When a separate guide roll 8 is used, the

differential angle α may also be controlled by moving the position of the guide roll 8. Analogously, the position transfer of the guide roll 8 may be implemented using a dedicated actuator means.

Claims:

1. Jet coating station for coating a moving web (1) of paper or paperboard, said jet coating station comprising

- a backing roll (2) arranged to support the moving web (1) over its travel about the backing roll from the tangential approach point (3) of the web (1) on the backing roll (2) to the tangential take-off point (4) of the web,

- a jet applicator (5) adapted to apply a jet stream of coating mix at a jet impact point (7) on the surface of the web (1), and

- a doctor means (6) adapted to smooth the coat applied as a jet stream on the web (1),

c h a r a c t e r i z e d in that said jet impact point (7) is located essentially on the perimeter of the backing roll (2) at a point whose angular displacement along the roll perimeter as seen from the center point (9) thereof forms an angle (α) of -5 - +15°, advantageously 0 - +10°, between the web approach point (3) and the jet impact point (7) when the positive direction of said angle (α) is defined as opposite to the travel direction of said web (1) (Fig. 2).

2. Applicator station according to claim 1, c h a r a c t e r i z e d by at least one guide roll (8) placed in front of the backing roll and adapted to pass said web (1) onto said backing roll (2) (Fig. 1).

3. Applicator station according to claim 2, c h a r a c t e r i z e d in that said at least one guide roll (8) is adapted to pass said web (1) onto said backing roll (2) essentially horizontally (Fig. 1).

4. Method of coating a moving web (1) of paper or board, in which method

- the web (1) to be coated is passed onto a backing roll (2), whereby the web (1) meets the backing roll (2) at an approach point (3),

- to the surface of the web (1) running supported by the backing roll (2) is applied coating mix in the form of a jet stream discharged from a jet nozzle (5) so as to hit the web surface at a jet impact point (7), and

- the applied coat is smoothed and doctored by a doctor means (6),

c h a r a c t e r i z e d in that the web (1) to be coated is passed onto said backing roll so that said jet impact point (7) is located essentially on the perimeter of the backing roll (2) at a point whose angular displacement along the roll perimeter as seen from the center point (9) thereof forms an angle (α) of -5 - +15°, advantageously 0 - +10°, between the web approach point (3) and the jet impact point (7) when the positive direction of said angle (α) is defined as opposite to the travel direction of said web (1) (Fig. 2).

5. Method according to claim 4, c h a r a c t e r i z e d in that

- the web (1) to be coated is passed onto the backing roll (2) over a guide roll (8),

- the path of the web (1) to be coated is deflected by means of the guide roll (8), and

- if necessary the position of the guide roll (8) is adjusted in order to change the deflected travel direction of the web (1) to be coated and to set the angular displacement (α) between the web approach point (3) and jet impact point (7).

6. Method according to claim 4, c h a r a c t e r - i z e d in that if necessary the position of the jet applicator nozzle (5) is adjusted in order to change the angular displacement (α) between the web approach point (3) and jet impact point (7).

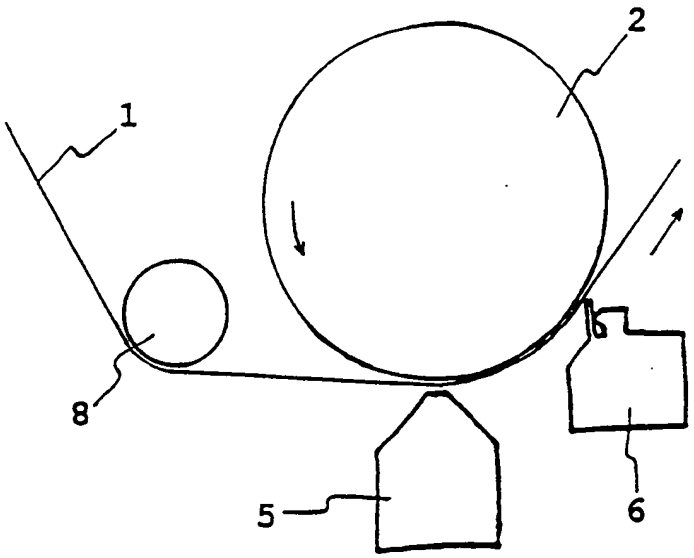

Fig.1

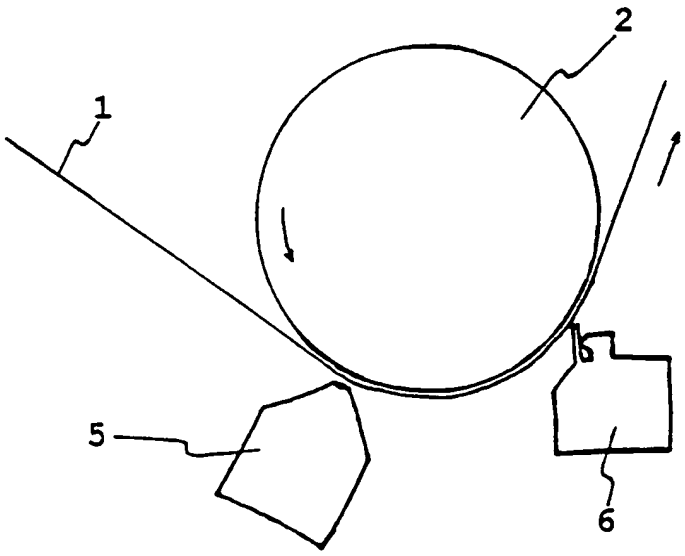

Fig.3

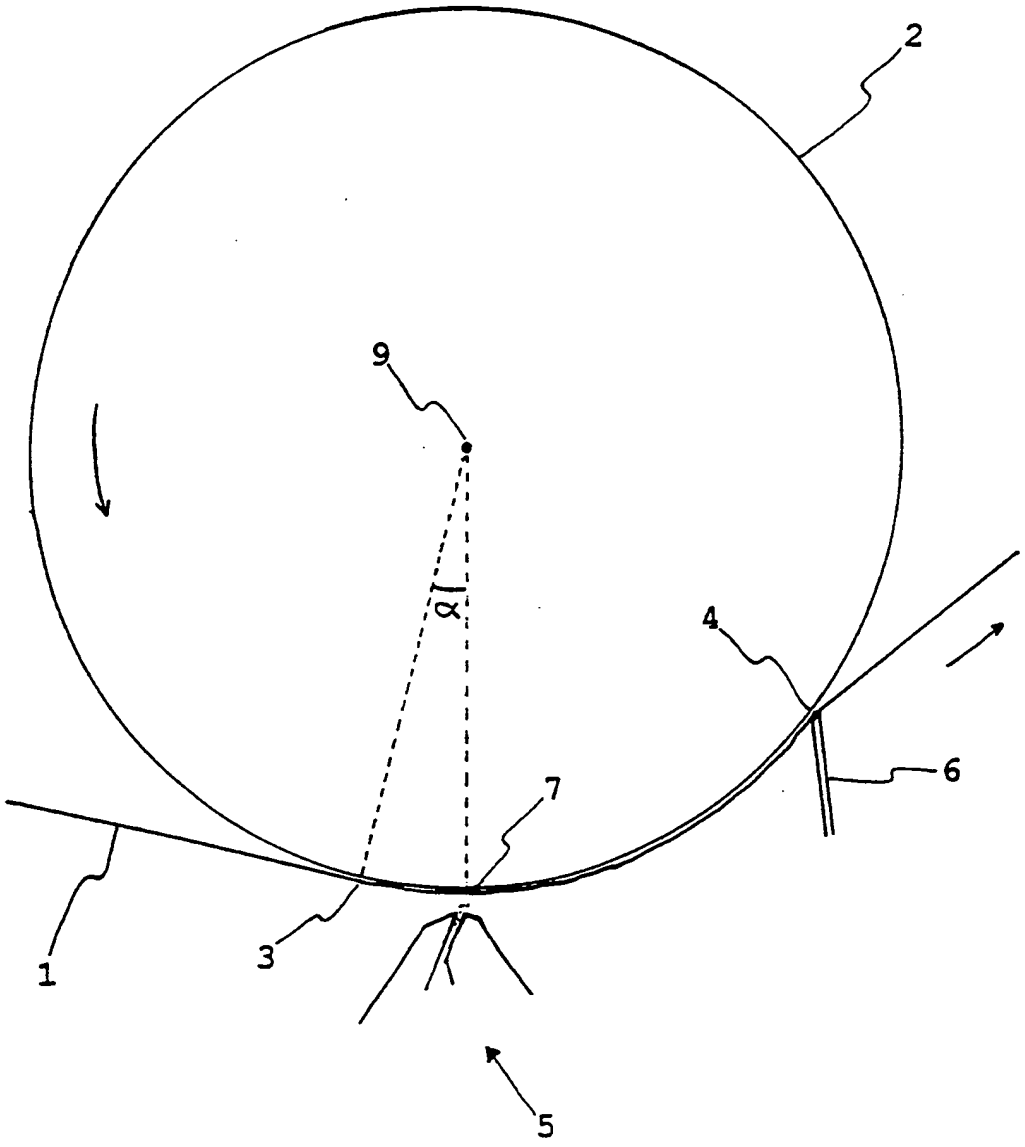

Fig.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00911

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21H 23/50, D21H 23/32
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0606874 A1 (VALMET PAPER MACHINERY INC.), 20 July 1994 (20.07.94), claim 1	1-6
A	US 5510150 A (JUKKA KOSKINEN), 23 April 1996 (23.04.96)	1-6
A	WO 9512031 A1 (J.M. VOITH GMBH), 4 May 1995 (04.05.95)	1-6

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Information on patent family members

02/02/99

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